MAGNITUDE AND ASSOCIATED FACTOR OF OXYGEN DESATURATION DURING RAPID SEQUENCE INDUCTION AND INTUBATION AMONG EMERGENCY AND ELECTIVE ADULT SURGICAL PATIENTS AT PUBLIC HOSPITAL ADDIS ABABA, ETHIOPIA: 2020/2021, CROSS-SECTIONAL STUDY.

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ATHESIS SUBMITTED TO THE DEPARTMENT OF ANESTHESIA COLLEGE OF HEALTH SCIENCES, ADDISABABA UNIVERSITY FOR PARTIAL FULFILLMENT OF THE REQUIREMENTS FOR A MASTERS DEGREE IN CLINICAL ANESTHESIA.

JULY, 2021

ADDIS ABABA, ETHIOPIA.

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Title of research	The Magnitude and Associated Factor of Oxygen Desaturation during Rapid Sequence Induction and Intubation at Public hospital, Addis Ababa, Ethiopia: cross-sectional study 2020/2021.
Duration of project	November 2020- May/ 2021
Study area	Addis Ababa, Ethiopia
The total cost of the project	29,843 Ethiopian, birr
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Annex I:

Declaration

The undersigned and declare that the research entitled Magnitude and Associated Factor of Oxygen Desaturation during Rapid Sequence Induction and Intubation at public hospital Addis Ababa Ethiopia; cross-sectional studies in partial fulfillment for the requirements of master's degree in Anesthesia all directly quoted material was appropriately referenced.

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Acknowledgment

Firstly I would like to express my respect and appreciation to my advisors Lidiya Haddis (B.Sc. M.Sc.) and Lemlem Getachew (B.Sc. M.Sc.) for their continuous support, constructive and valuable comments in each & every step of this thesis work. Secondly, I would like to extend my appreciation to Addis Ababa University for giving me this opportunity to develop this thesis and financial support and Anesthesia Department for its continuous encouragement and support throughout this work.

Finally, I would like also to thank the authors of the articles I used for this thesis as a reference, thanks to my data collector, my teachers, and my friends.

Acronyms and Abbreviation

ASA	American Society of Anesthesiologist
AOR	Adjusted Odds Ratio.
BVM	Bag Valve Mask
COR	Crude Odd Ratio
OPV	Oro Pharyngeal View
RSII	Rapid Sequence Induction and Intubation
TASH	Tikur Anbessa Specialized hospital
SPO2	Oxygen Saturation

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ABSTRACT

Introduction: Rapid sequence Induction and Intubation is a basic airway management technique for patients who have risks for pulmonary aspiration. This technique was designed to minimize the unprotected airway time and reduce the risk of aspiration during that short period. Patients classified to be desaturated when the oxygen saturation level was less than 90%

During Anesthesia the patient became unconscious and loses the ability to keep the airway it is important to monitor the patients' oxygen saturation level with pulse oximetry.

Objective: To determine the Magnitude and Associated Factor of Oxygen Desaturation during Rapid Sequence Induction and Intubation in the public hospital, Addis Ababa Ethiopia.

Method: cross-sectional study design was conducted at four Addis Ababa referral Hospitals and selected by using the lottery method. Data were collected from January 30 to April 30, 2021, using a pretested questioner. The sample size was calculated and convenience sampling techniques were applied for 336 patients included in the study, the data were entered and analyzed by SPSS version 24 software performing descriptive statistics, bivariate and multivariable logistic regressions.

Result: The Magnitude of Oxygen Desaturation during RSII was found in 56 patients 16.7 %. The minimum and maximum Oxygen desaturation periods were 10 and 120 seconds respectively. Patients who have documented respiratory disease have 4.45 times [AOR=4.459; 95% CI: (1.467-13.549)], patients not preoxygenated, 15.25 times [AOR= 15.253; 95% CI: (1.760-132.185)], those preoxygenated <3 minutes have 15.2 times [AOR =15.299; 95% CI: (2.770-84.499)] and those who have difficult intubation have 17.7 times [AOR=17.778; 95% CI: (8.971-35.229)] a high risk of developing Oxygen Desaturation.

Conclusion and recommendation; The Magnitude of Oxygen Desaturation during Rapid Sequence Induction is relatively low. Patients who have documented respiratory disease, those are not preoxygenation, preoxygenation time <3 minutes and difficult intubation are associated with oxygen desaturation during RSII, so preoperative optimization of patients who have respiratory disease, preparation needs before RSII based on Checklist, and adequate preoxygenation of patients for 3 to 5 minutes is important.

Chapter One: Introduction

1.1.Background:

Rapid Sequence Induction and Intubation is the basic of emergency airway management. It was described in 1961 by Sellick1 for patients with a risk of pulmonary aspiration. It involves preoxygenation, administration of predetermined doses of induction and paralytic drugs, avoidance of mask ventilation, and perform laryngoscopy and secure the airway using an endotracheal tube, and keeping cricoid pressure applied till endotracheal tube cuff be inflated (1) (2).

Rapid sequence induction and intubation is the administration of a potent induction agent followed by a fast-acting neuromuscular blocking agent to facilitate unconsciousness and motor paralysis for tracheal intubation, applied Cricoid pressure from the moment the patient loses consciousness until the endotracheal cuff is inflated (3), (4).

Oxygen Desaturation defines: In pulse oximetry, the condition of a low blood oxygen concentration. According to WHO definition patients consider desaturated if the oxygen saturation level was less than 95% (5).

In a patient breathing room air before rapid sequence tracheal intubation (PaO2 is 90 to 100 mm Hg)(6). Desaturation was also defined as a reduction in SpO2 to less than 90% or a reduction of more than 10% (7)When the SpO2 falls below 90%, the patient is becoming seriously hypoxic(8). Hypoxemia was graded into four values of SpO2: mild hypoxemia (86-90%), moderate hypoxemia (81-85%) ,severe hypoxemia (76-80%), extreme hypoxemia<76% (9).

Desaturation during intubation has been associated with serious complications, including dysrhythmias, hemodynamic decomposition, hypoxic brain injury, and cardiac arrest(10).

1.2. Statement of problem

Rapid sequence induction may be associated with hypoxemia. Since bag-mask ventilation may inflate the stomach increases the risk of vomiting and aspiration, any form of mask ventilation is not recommended during RSII. Apnea is always present during rapid sequence induction of general anesthesia. It is potentially life-threatening or organ damage if it is in-adequately managed, (11).

Hypoxemia is one of the most challenging critical incidents during anesthesia. It occurs commonly after general anesthesia is documented even after a minor procedure. It happened most often during the induction and emergence phase. Severe hypoxemia can kill a patient or leave the patients with complicating neurological problems made a significant impact on the practice of anesthesia(12),(9).

Researches did by Canadian anesthesiologists in two institutions despite in advances monitoring technology, hypoxemia continues to occur commonly in the operating room and maybe a serious safety concern because of its potential impact on end-organ function and long-term outcomes(13).

Researches did in two large academic tertiary hospitals results show that a high percentage of patients experience sustained hypoxemia during surgery. Approximately one in 15 patients experienced hypoxemia for at least two consecutive minutes, and one in 64 patients experienced hypoxemia for at least five consecutive minutes. These frequencies are likely higher in resource-limited settings throughout the world where pulse oximetry is often unavailable, and hypoxemia may not be recognized by the perioperative team(13).

A study conducted at the University of Gondar Oxygen desaturation has been seen during RSII and the rate also high(35.9%) no more researches done in our country except one research was done at the University of Gondar in 2014(10).

Oxygen desaturation is the commonest complication for emergency patients, and researchers emphasize preoxygenation as an important part of RSII, because inadequate preoxygenation may be one cause of patient desaturation and most textbooks recommend preoxygenation for at least 3 -5 minutes(1), (14), (15),(16).

Desaturation during intubation is associated with serious complications, patients may develop dysrhythmias, hemodynamic instability, if the oxygen saturation level is <70 % the hypoxic brain injury and cardiac arrest will occur(10). The inappropriate technique of rapid sequence

induction by most anesthesia professionals results in a high chance of failure to secure the airway, experiencing regurgitation, hypoxia, and patient death(14).

Studies show that the broad difference techniques of RSII are possibly due to the absence of RSII protocols in the institution and medical review, this different technique predisposes patients to desaturation (17).

1.3. Justification of study

Rapid sequence induction is commonly done in emergency surgery and researches' shows oxygen desaturation is common in the emergency patient so it is important to the rates and the factor associated with oxygen desaturation during RSII could influence practice, identifying an opportunity to improve rapid sequence intubation technique or application of strategies to prevent desaturation event.

In a national survey and online survey was done in 56 countries about the practice of RSII, there was a difference in the practice of RSII amongst the anesthesia professionals, this variation needed international RSI guideline formation to improve the safety of the patients. (18). (19).

Studies conducted at Gondar University also suggest Because of no common working guideline about the practice of RSII in the working area, desaturation, and other complications may occur.

This study aims to answer the Magnitude and associated factor of oxygen desaturation during rapid sequence induction and intubation helps to improve practice regarding rapid sequence induction, Deliver safe anesthesia for a patient who has the risk of aspiration. and also when the research is published it helps us a reference for other hospitals.

Chapter Two. Literature review

2.1. Incidence of Oxygen Desaturation

RCT and observational study conducted in Carolina University in 2020, desaturation during RSI in the emergency case was common and, when the desaturation is severe, it can result in life-threatening complications. The study concluded the use of apneic oxygenation is important to decrease the prevalence of hypoxemia during the peri-intubation period and they include in RSI protocol and it decreases the prevalence of desaturation <93% decrease from 23% to 17% (18).

A multicenter and prospective observational study conducted in 2019 hypoxemia occurred more frequently with rapid sequence induction of anesthesia management with an Incidence rate of 12.9% (20).

A prospective randomized controlled trial study conducted in Switzerland in 2011 shows the incidence of oxygen desaturations observed by continuous pulse oximetry measurement at the beginning of the induction time and 2 minutes later after the completion of the intubation with comparing Suxamethonium and rocuronium, the incidence of desaturation with Suxamethonium group is 37% and rocuronium group is 34% (21).

In a randomized controlled trial study conducted at the University of California in 2003, 54 trauma patients were operated under general anesthesia with RSII from this 57% shows desaturation.26 of patients' baseline oxygen saturation was greater than or equal to 90%. the median duration of desaturation was 2 minutes, (IQR=48 to 272 seconds), the median spo2 decrease 22%, six (19%) patients experienced bradycardia (PR<50 beats/min) during the desaturation period. In elective gynecological surgery, 108 patients were involved in a study period from that 57 % rate of desaturation seen and desaturation of less than 90% occurred in 11 patients(10%),5 patients with SpO2 values of less than 85% (22).

A Meta-analysis study conducted in American in 2008 shows that patients preoxygenated for 3 minutes after that sedatives and muscle relaxants were given their saturation level decrease from 100% to 95%, from 101 patients managed by anesthesiologist oxygen desaturation less than 90% happened in 15 patients (15%) (23). A Meta-analysis study conducted by Cochrane Collaboration in 2008 shows succinylcholine creates faster intubation conditions more reliably than rocuronium and it is preferable for rapid sequence induction intubations. when succinylcholine is contraindicated rocuronium can be used as a second-line choice(23).

A Prospective Randomized Control Trial study conducted in King Khalid University Hospital, Riyadh, Saudi Arabia in 2004, when the dose of succinylcholine decrease from 1mg to 0.56 mg/kg the incidence of oxygen desaturation decrease from 85% to 65%, but In another report, Hayes et al. concluded that the use of 1.0 mg/kg succinylcholine may not always prevent desaturation if there is a difficulty to intubate and ventilate during a rapid sequence induction of anesthesia (24).

Randomized Controlled Trial study conducted in the University of California in 2001, the maximum and lower dose of succinylcholine, is in controversy for the actual dose than the currently acceptable dose 1 to 1.5 mg/kg. previously defasciculation dose of other muscle relaxant recommended before succinylcholine during RSII but currently it is controversial and avoids the use of opioids before induction (4),(25).

RCT and observational study conducted at Carolina University in 2020 shows patients in the operating room with head-up position results in improved preoxygenation and increases the safe apnea time(18).

In an institutional-based observational study conducted at the University of Gondar in 2014, 153 patients have included their study that the response rate was 91.6% and the incidence of oxygen desaturation during RSII occurs in 55 patients (35.9%) The minimum and maximum desaturation levels were 26% and 70.9% respectively (3).

In an institutional-based observational study conducted in Gondar university in 2014,153 patients were involved in the study and 55 patients were desaturated from those, 6 patients the range of desaturation level was<50 %(3.9%), 7 patients 50-64 % (4.6%) 5 patients 65–74% (3.3%),10 patients 75–84%,(6.5%),13 patients 85-95%(8.5%) and 14 patients 90-94%, 18 patients were ventilated during hypoxia period with face mask until they recover from hypoxia before intubation and the rest 37 patients were ventilated after airway secure. Of 153 patients 43 patients are managed by M.Sc. Anesthetists, from those 7 patients (4.6%) are desaturated from 110 patients 16(10.5%)were desaturated who managed by B.Sc. Anesthetists (3). An institutional-based observational study conducted at the University of Gondar in 2014 shows that complications after RSII occurs hypoxia (SpO2<90%), difficult airway difficult laryngoscopy, hypertension, hypotension, tachycardia and bradycardia 35.9%, 15%, 8.5%, 13.1%, 15%, 32.7%, 5.2% of patients respectively (3).

2.2. Factors related to Oxygen Desaturation during Rapid Sequence Induction and Intubation

In a cross-sectional study conducted in the American college of emergency in 2011, there were 265 patients done with RSII oxygen, desaturation occurred in 59 patients (35.5%) Multivariable analysis shows that oxygen desaturation was associated with pre intubation SpO2 less than 93% AOR=5.1; 95% CI:(2.3 to 11.0 attempts of intubation >1[AOR= 3.4; 95% CI (1.4 to 6.1),] and duration of intubation greater than 3 minutes [(OR =2.7; 95% CI (1.2 to 6.1)](10).

A randomized Control Trial study conducted at the University of Arizona in 2016 shows that Success of intubation with First attempt has decreased the incidence of oxygen desaturation but it may be affected by different factors like difficulty to visualize the airway and placement of the tracheal tube if, the patients are Physiologically disturbed they have not tolerated repeated attempts during laryngoscopy because of this common complications occurs like hypoxia, and hemodynamic deterioration(26).

Randomized Control Trial study conducted in Ottawa Hospital and the University, in 2007 The risk of aspiration increases directly with increasing ASA physical status; there is a seven times increase in risk when the level of ASA status increases. Study shows in Gondar university Based on ASA classification from 124 ASAI patients 19 patients (12.4%) were desaturated, ASA II patients were 26 and from this 3 patients (1.9%), 6 patients were ASA III and 1 patient (0.7%) were desaturated (1), (3).

An institutional-based observational study conducted at the University of Gondar in 2014 shows that the experiences of anesthetists highly affected their techniques of RSII. 85 of them performed by <1 Year of experience of anesthetist from those 12 patients were desaturated (7.8%), by 1-2 year of experience anesthetist 21 patients are performed from those 4 patients were desaturated (2.6%), 3-5 year experience anesthetist 29 patients were performed and from those 4 patients are desaturated (2.6%), >5 years' experience 16 patients were performed and 3 patients were desaturated and also the urgency and specialty of surgery, qualifications of anesthetists, highly affected the occurrence of oxygen desaturation during RSI (1.9%) and occurrence of difficult airway observed in 23 patients 21 of them (13.7%) were Emergency and 2 (1.3%)elective patients (3).

An institutional-based observational Study conducted by Gondar University in 2014, recommended the use of an emergency intubation checklist to ensure that all equipment is

available and in working order, and also all team members understand their working responsibility and share with others.

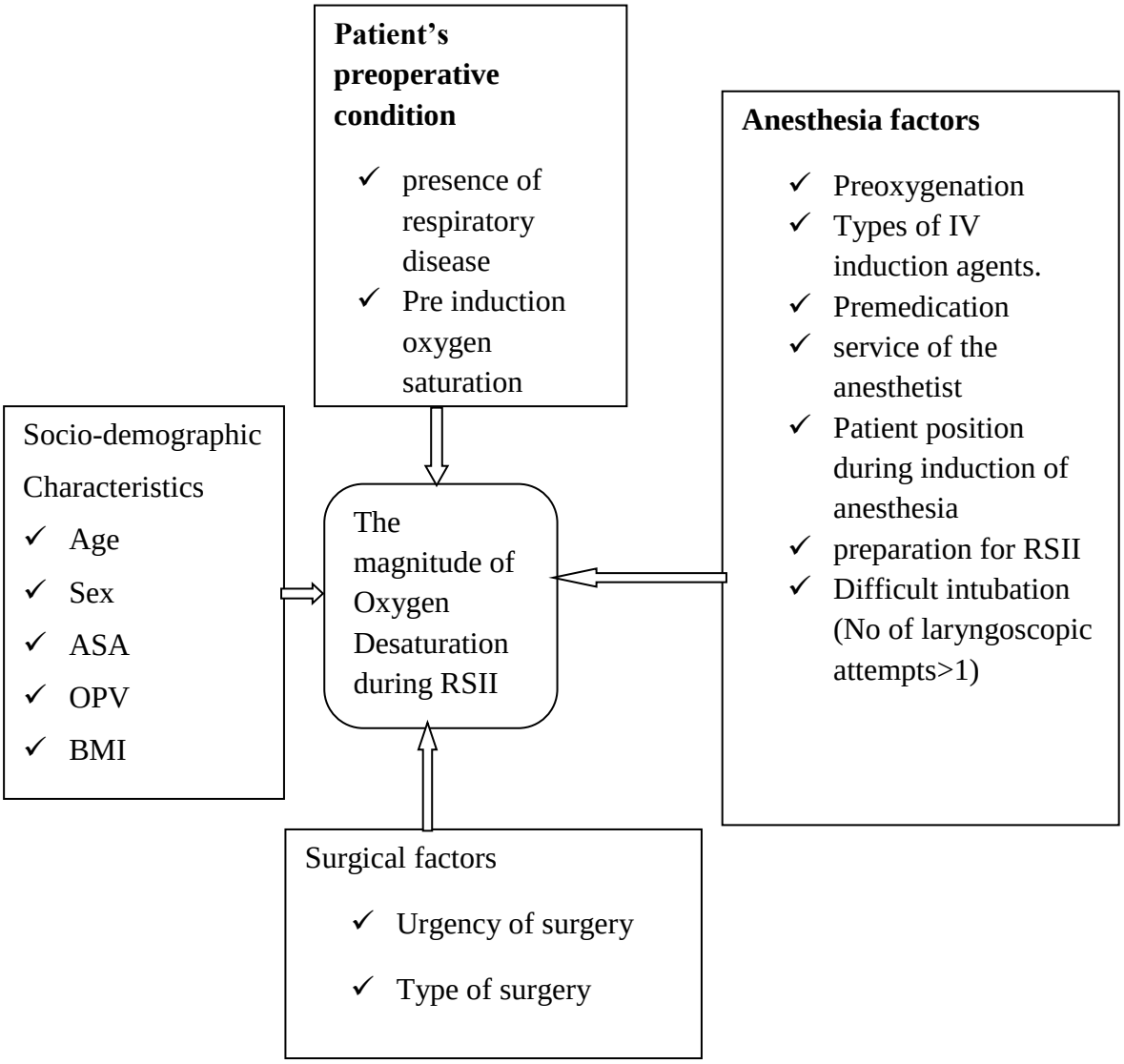

Figure 1: Conceptual framework

Chapter Three: Objective

3.1.General objectives

- To Determine the Magnitude and Associated Factors of Oxygen Desaturation during Rapid Sequence Induction and Intubation.

3.2.Specific objectives

- To assess the Magnitude of Oxygen Desaturation during Rapid Sequence Induction and Intubation.
- To Identify Associated Factors of Oxygen Desaturation during Rapid Sequence Induction and Intubation.

Chapter Four: Methods

4.1. Study area

The study was conducted in four Addis Ababa city administrations, which is the capital city of Ethiopia. With an average elevation of 2500 meters above sea level, the city administration has a geographic and territorial possession with an area of 540sq. km and a total population of about 4 million. There are 79 government-owned health facilities in the city administration: 13 hospitals, 23 health centers, 9 clinics, and 34 health posts from 13 hospitals TASH Minilik Referral hospital, Zewuditu Memorial hospital, and st Paulo's hospitals were selected.

4.2. Study design and period

A cross-sectional study was conducted from January 30 to April 30, 2021

4.3. Source population

All elective and emergency patients were operated on under general anesthesia at a public hospital.

4.4. Study population

All emergency and elective patients were operated on with RSII under general anesthesia.

4.5. Eligibility criteria

4.5.1. Inclusion criteria

- All elective and emergency patients undergo RSII

4.5.2. Exclusion criteria

- Pre induction pso_2 level <90%
- Pediatrics(age <18 years)
- Pregnancy
- Patient ventilate before intubation

4.6. Sample size and sampling technique

4.6.1. Sample size determination

The sample size was estimated using the single population proportion formula. The p-value is taken from the previous study at the University of Gondar with a prevalence of oxygen desaturation during rapid sequence induction is 35.9% (3).

$$n = \frac{(z^2 a/2p)(1-p)}{w^2}$$

$$n = \frac{(1.96)^2(0.359)(1-0.359)}{0.05^2}$$

$$n = \frac{(1.96)^2(0.359)(0.641)}{0.05^2}$$

$$n = 353$$

Where α=the level of significances which can be obtained as 1-confidence level.

P=best estimate of the population proportion.

W=Maximum acceptable difference

z $\alpha/2$=the value under the standard normal table for the given value of confidence level. The final sample is calculated by adding (5% of contingency) N1=n/ (1-d)

Where N1 is adjusted sample size, n is the sample size required per formula

d is dropout rate (5% contingency) 353/ (1-0.05)

- The final sample size will be 372

To calculate sample size for each hospital

$\boldsymbol{nj}=\frac{\boldsymbol{n}}{\boldsymbol{N}}\boldsymbol{Nj}$=1, 2, k where k is the number of strata and n j=is the sample size of each hospital allocation.

Nj=is the source population size of each hospital

n=n1+n2+n3+n4=is the total sample size

N=N1+N2+N3+N4=the total population size of each hospital

TASH=225, Zewuditu memorial hospital =235, Minilk referral hospital =383

Paulo's =253 this source number is depending upon the situational analysis' the previous surgery per 3months on the logbook in each hospital, all are emergencies.

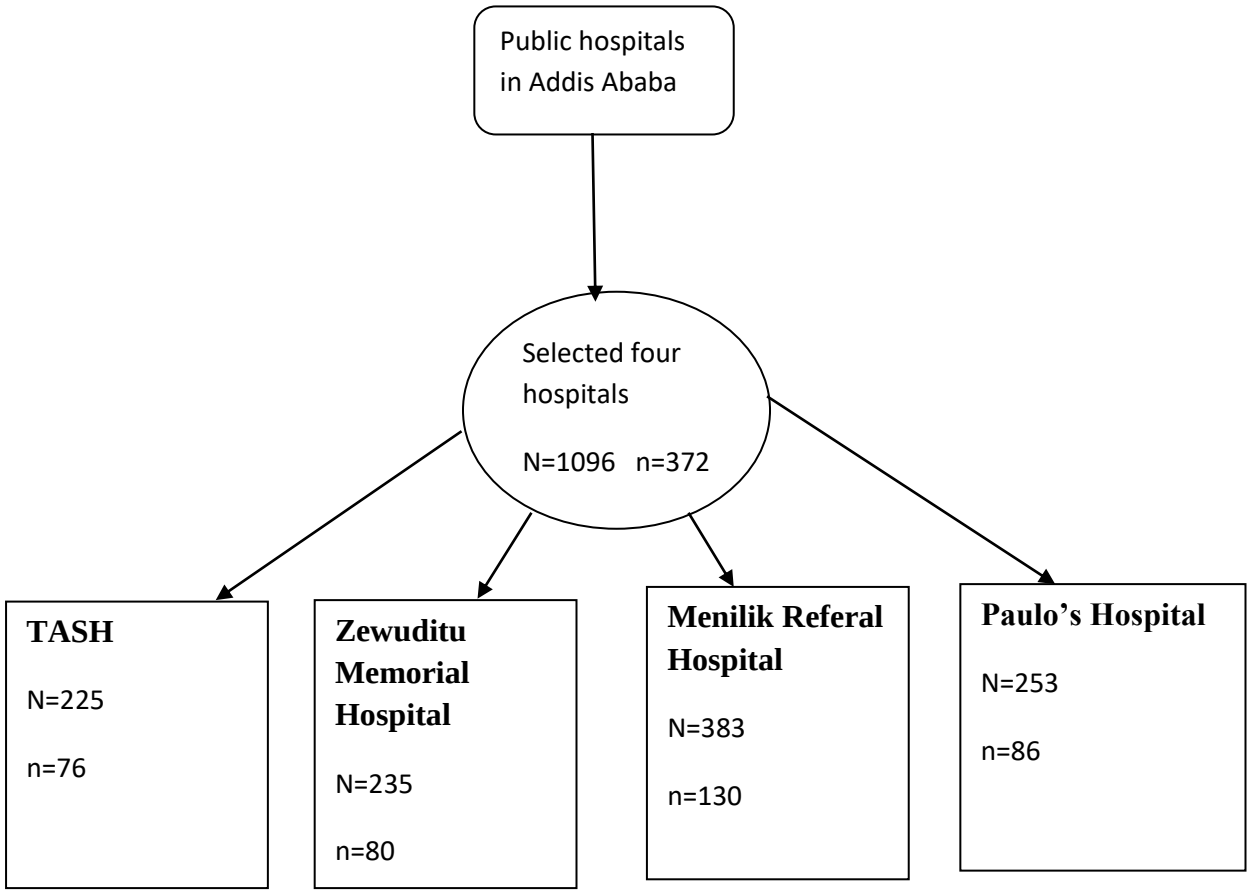

Figure 2: Sample size distribution in each hospital

4.6.2. Sampling technique

Convenience sampling techniques were used to get the required sample size during the study period.

4.6.3. Data collection technique

Data were collected from selected study participants with 5% of pretested questioner observing saturation level from anesthesia management during RSII, relevant information was taken from patient records, the procedure was performed with B.Sc. holder Anesthetist, M.sc holder Anesthetist, and Anesthesiologist. Data was collected by BSC holder nurses, Anesthesia professionals, and students.

4.7. Study variables

4.7.1. Dependent variable

- Oxygen Desaturation During RSII

4.7.2. Independent variable

Socio-demographic

- Age , sex, ASA status, OPV status, BMI

Anesthesia factors

- Preoxygenation, Experience of Anesthesia provider, premedication, preparation (Equipment, patient, drugs), Types of drugs for induction, Difficult intubation (Attempts of intubation>1).

Surgical factors

- Type of operation, Surgical subspecialty

Patient factors,

- Presence of respiratory disease,
- History of cigarette smoking.
- Patient position during induction of anesthesia.

4.8. OPERATIONAL DEFINITIONS.

Preoxygenation: is the administration of oxygen to a patient before induction for 3-5 minutes or vital capacity breathing technique (taking 8 deep breathes for 60 seconds).

Desaturation: the patients were considered as having desaturated when the oxygen saturation level was <90%. Lower oxygen saturation was assessed by monitoring with pulse oximetry at any time between the start of induction of anesthesia and the completion of the intubation.

RSII: A technique which consisted of preoxygenation, rapid administration of both induction and paralytic drugs with rapid onset and offset of actions, application of cricoid pressure, avoidance of bag and masks ventilation, and performs direct laryngoscope, secure the air way by endotracheal tube and cricoid pressure applied till confirmation of its correct placement.

RSI start- is the time of the first intravenous anesthetic drug administration for RSI,

RSI end -the time confirmation of correct tube placement

The magnitude of hypoxemia;-

- Mild hypoxemia defined when the pso2 level was (86-90%),
- Moderate hypoxemia (81-85%),
- Severe hypoxemia (76-80%) and
- Extreme hypoxemia <76%.

4.9. Data quality assurance

To ensure the quality of data pretest was done on 5 % of the sample size. The training was given on the importance of the study and brief Orientations on the assessment tools for data collectors. During data collection, each questioner was checked by the investigator for being complete and appropriate.

4.10. Data processing and analysis

Data were coded and then entered manually, cleaned, and edited to Statistical Package for Social Sciences (SPSS) software version 24.0, for socio-demographic variables and Magnitude and Associated Factor of Oxygen Desaturation during RSII, basic descriptive statistics like frequency and cross-tabulation was done; Binary logistic regression analysis was carried out to examine the predictors of the outcome variable. On binary logistic regression analysis, a P-value of ≤0.2 was a candidate for multivariable logistic regression

analysis. It was performed to identify independently associated factors for Magnitude of Oxygen Desaturation during RSII. By COR and AOR P-value <, 0.05 considered as significant. The result was presented by using text, tables, and charts.

4.11. Ethical consideration

Ethical clearance and approval were obtained from the ethical review committee, Addis Ababa University Department of Anesthesia. Permission to conduct was obtained from a Public hospital. Informed verbal consent was obtained from every study participant. Confidentiality and anonymity were ensured.

4.12. Result dissemination plan

The result of the study will be submitted to Addis Ababa University, College of Health science, department of Anesthesia, for each public hospital, the Ethiopian Anesthetist Association, and other responsible bodies. The result will be presented at the college of medicine and health science in different seminars, meetings, conferences, and workshops. Moreover, efforts will be done to publish the findings of the study and disseminated them through different journals and scientific publications.

5. Results

5.1. Socio-demographic and surgical characteristics of patients who underwent RSII.

During the study period, data was collected from 372 patients 336 patients included in the study, and 36 patients are excluded from the study due to 25 of patients ventilate during induction of anesthesia and the other 11 patients data was incomplete, the response rate was 90% Most of the patients were ASA I and the mean age of the patient were 35 years, the minimum and maximum age was 18 and 91 years old respectively. All patients' preoperative oxygen saturation was above 90% and most of the procedures were handled by B.Sc. Anesthetists.

Table 1: Socio-demographic and clinical character of patients who underwent surgery with RSII at a public hospital from January 30 to April 30, 2021 (n=336)

Variable	Category	Frequency(percent)
Sex	Male	214(63.7)
	Female	122(36.3)
BMI	(18.5-24.9)	276(82.1)
	(25-29.9)	54(16.1)
	(>30)	6(1.8)
ASA	ASA I	240(71.4)
	ASA II	84(25.0)
	ASA III	12(3.6)
OPV STATUS	OPV I	210(62.5)
	OPV II	99(29.5)
	OPV III	27(8.0)
Types of operation	Elective	62(18.5)
	Emergency	274(81.5)
position of the patient during induction	Supine	329(97.9)
	Semi sitting	4(1.2)
	Lateral	3(0.9)
Qualification o anesthetist	BSC Anesthetist	170(50.6)
	MSC Anesthetist	49 (14.6)
	Anesthesiologist	117(34.8)
Experience of anesthetist	<1 year	16(4.8)
	1-2 year	95(28.3)
	3-5 year	139(41.4)
	>5 year	86(25.6)

5.2. Preoperative patient status and preparation for RSII.

Of 336 patients for 48 of them, Equipment was not prepared for difficult intubation.

Table 2: Preoperative patient status and preparation who underwent surgery with RSII at a public hospital from January 30 to April 30, 2021 (n=336).

Variable	Category	Frequency(percent)
Baseline blood pressure	1. Systolic BP<120 and Diastolic <80 mmhg	152(45.2)
	2. Systolic BP120-129 and Diastolic BP <80 mmhg	80(23.8)
	3. Systolic BP 130-139 and Diastolic BP 80-89 mmhg	71(21.1)
	4. Systolic BP>140 and Diastolic BP >90 mmhg	33(9.8)
Presence of respiratory disease	Yes	37(11.0)
	No	299(89.0)
History of documented cigarette smoking	Yes	26 (7.7)
	No	310 (92.3)
Equipment prepared for difficult intubation	Yes	288(85.7)
	No	48(14.3)
suction machine with catheter prepared	Yes	323(96.1)
	No	13(3.9)
A checklist for RSI is prepared	Yes	54 (16.1)
	No	282 (83.9)
Does the patient take opioid analgesia	Yes	164(48.8)
	No	172(51.2)

5.3. Techniques of Rapid Sequence Induction and Intubation

322(95.8%) patients were pre-oxygenated but 14 patients not pre-oxygenated during RSII. No one used a vital capacity breathing technique. Most of the patients 155(46.1%) induced by ketamine and choice of muscle relaxant for all patients were suxamethonium.

Table 3: Techniques of rapid sequence induction and intubation who underwent surgery with RSII at a public hospital from January to April 30, 2021 (n=336)

Variable	Category	Frequency (percent)
Does the patient pre oxygenated	Yes No	322(95.8) 14(4.2)
Time allowed for preoxygenation	<3 minutes 3-5 minutes >5 minutes 8 deep breath /60 second	182(54.2) 108(32.1) 32(9.5)
Difficult intubation during RSII	Yes No	59(17.6) 277(82.4)
Drugs for Induction	1. Ketamine 2. Theopentone 3. Propofol 4. Ketopropofol	155(46.1) 65(19.3) 30(8.9) 86(25.6)
Muscle relaxant	Suxamethonium	336(100)

5.4. The magnitude of Oxygen Desaturation during RSII

From the total patient underwent RSI the Magnitude of Oxygen Desaturation was observed in 56 patients (16.7%). Among them, 45(13.4%), 10(3%), 1(0.3) patients have mild, moderate, and extreme hypoxemia respectively.

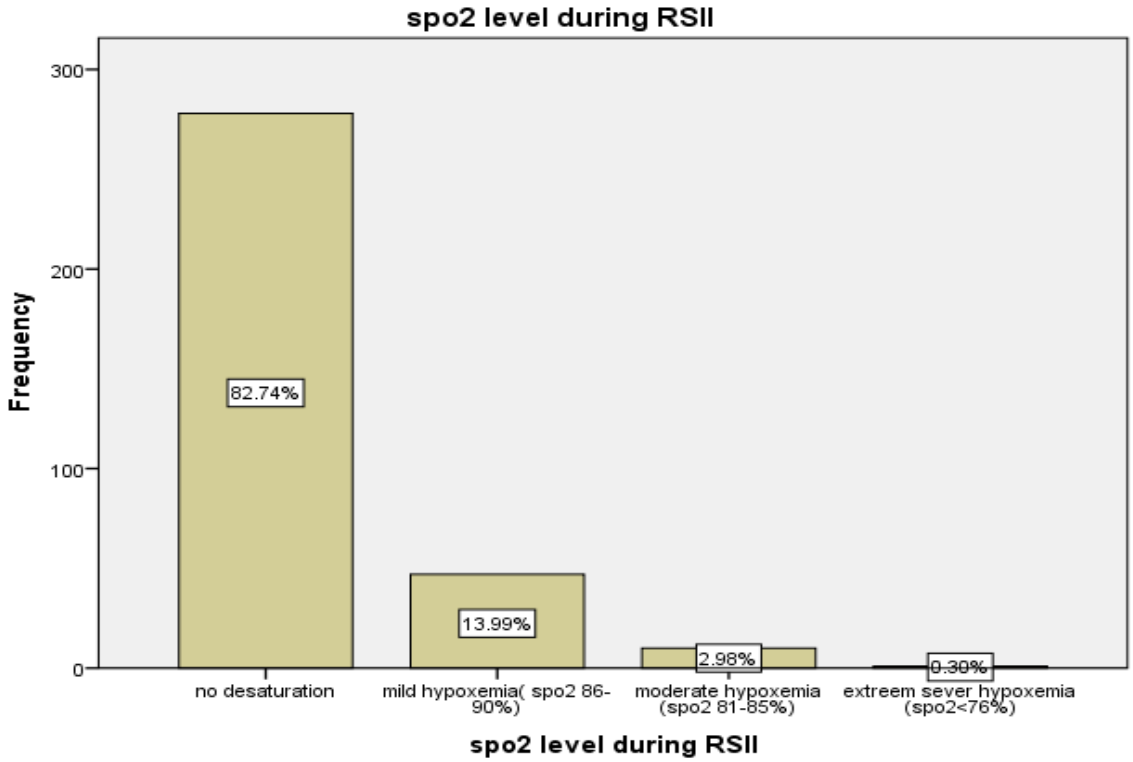

Figure 3: Magnitude of Oxygen Desaturation during RSII. (n=336).

5.5. Factors associated with oxygen desaturation during RSII

5.5.1. Result of binary logistic regression

Patients who underwent emergency surgery were 2times more likely of developing oxygen desaturation[COR=2.035; 95% CI :(1.051-3.938)], in comparison to elective patients.

Patients who take opioid during induction of anesthesia were 1.4 times more likely of developing oxygen desaturation [COR=1.495; 95%CI :(0.838-2.667)], in comparison with who do not takes opioids, ASA III patients were less likely developed oxygen desaturation [COR=0.383; 95%CI :(0.166-0.886)] in comparison with ASA I, and ASA II patients.

Patients who have the previous documented respiratory disease were 3.7 times more likely of developing oxygen desaturation [COR 3.725: 95% CI: (1.777-7.808)], in comparison with those who have no respiratory disease.

Patients who didn't pre-oxygenate 4 times more likely developing of oxygen desaturation [COR =4.080; 95% CI: (1.357-12.265)], in comparison with preoxygenated patients.

Patients those preoxygenation <3 minutes were 5 times more likely of developing oxygen desaturation [COR =5.250; 95%CI :(1.184-23.278)], in comparison with 3 to 5 minutes and > 5 minutes preoxygenation.

Patients who have Difficult intubation during RSI were 17.7 times more likely developing of oxygen desaturation[COR= 17.778;95%CI: (8.971-35.229)] in comparison to those who did not have difficult intubation. Patients who have documented cigarette smoking 2.9 times developing oxygen desaturation [COR= 2.962; 95% CI :(1.247-7.040)] in comparison to non-smokers.

Table 4: Factors associated with Oxygen Desaturation during RSII

Variable	Category	Oxygen Desaturation during RSII		COR 95%CI	P-value
		Yes (%)	No (%)		
Urgency of procedure	Emergency	40 (71.4)	234 (83.6)	2.035(1.051-3.938)	**0.035**
	Elective	16 (28.6)	46 (16.4)	1	
Patients who takes Opioid	Yes	32(57.1)	132 (47.1)	1.495(0.838-2.667)	**0.173**
	No	24(42.9)	148(52.9)	1	
ASA class	I	46(82.1)	194 (69.3)	1	
	II	7(12.5)	77 (27.5)	1.406(0.366-5.399)	0.620
	III	3(5.4)	9 (3.2)	0.383(0.166-0.886)	**0.025**
Documented respiratory disease	Yes	14(25.0)	2 3(8.2)	3.725;(1.777-7.808)	**0.000**
	No	42(75.0)	257(91.8)	1	
Preoxygenation	Yes	50(89.3)	272(97.1)	4.080(1.357-12.265)	**0.0012**
	No	6(10.7)	8(2.9)	1	
Time allowed for preoxygenation in minute	<3	38(67.9)	144(51.4)	4.080(1.357-12.265)	**0.029**
	3-5	8(14.3)	100 (35.7)	1.847(0.611-5.588)	0.277
	>5	4(7.1)	28 (10.0)	1	
Difficult intubation	Yes	35(62.5)	24(8.6)	17.778(8.971-35.229)	**0.000**
	No	21(37.5)	256(91.4)	1	
Documented cigarette smoking	Yes	9 (16.1)	17(6.1)	2.962(1.247-7.040)	**0.014**
	No	47(83.9)	263(93.9)	1	

5.5.2. Result of multiple logistic regression

Variables that fit the final model on binary logistic regression (p-value <0.2) analyzed on multivariable regression. The result showed patients who have documented respiratory disease with [AOR =4.459; 95%CI :(1.467-13.549)] patients who do not preoxygenated, [AOR= 15.253; 95%CI: (1.760-132.185)] those pre oxygenated <3 minutes [AOR =15.299; 95 CI :(2.770-84.499)] and those who have difficult intubation [AOR=22.660 95%CI:(9.842-52.172)]are highly associated with developing oxygen desaturation during RSII, Statistically significant p-value< (0.05).

Table 5: Results of variables in multivariable logistic regression analysis n=336

Variable	Category	Oxygen desaturation during RSII Yes	No	COR:95% CI	AOR	P-Value
Documented respiratory disease	Yes	14(25.0)	2 3(8.2)	3.725 (1.777-7.808)	4.459(1.467-13.549)	**0.008**
	No	42(75.0)	257(91.8)	1	1	
Preoxygenation	Yes	50(89.3)	272(97.1)	1	1	
	NO	6(10.7)	8(2.9)	4.080(1.357-12.265)	15.253(1.760-132.185)	**0.013**
Time allowed for preoxygenation	<3minutes	38(67.9)	144(51.4)	5.250(1.184-23.278)	15.299(2.770-84.499)	**0.002**
	3-5 minutes	8(14.3)	100 (35.7)	1.847(0.611-5.588)	1.876(0.319-11.034)	0.486
	>5 minutes	4(7.1)	28(10.0)	1	1	
Difficult intubation	Yes	24(8.6)	35(62.5)	17.778(8.971-35.229)	22.660(9.842-52.172)	**0.000**
	No	21(37.5)	256(91.4)	1	1	

6. Discussion

The finding of this study shows the Magnitude of Oxygen Desaturation during Rapid Sequence Induction and Intubation was 16.7%, which is slightly higher than M.Helm, et al and Bail lard et al study with an incidence rate of13.3% and,12.9% respectively (7),(20), the higher percentage might be related to inadequate preoxygenation, it is low when we compared to the University of Gondar with the incidence rate was 34 %(3), and American study (35.5%) (10) this might be due to difference the population size and they include in their study the preoperative pso2 level <90%.

There is a significant risk of developing oxygen desaturation in patients who have documented respiratory disease 4 times [AOR=4.459; 95%CI: (1.467-13.549) this might be due to decreased ventilatory drive(27).

In the present study patients who do not pre oxygenated 15 times of likely developing oxygen desaturation [AOR =15.253, 95%CI :(1.760-132.185)] than pre oxygenated patients, this result shows Maintaining oxygen pso2 is critical during airway management, the challenge during RSII is maintaining oxygen pso2 level. preoxygenation is important to increase the oxygen reserves of the body and preventing hypoxia during a planned or unexpected period(28). ,(29) ,(30).

In a study done by Hong Kong, On RSII about preoxygenation and prevention of oxygen desaturation in the emergency patient, three-minute tidal volume breathing is the acceptable duration of preoxygenation or for cooperative patient pre oxygenated by taking 8 vital capacity breath for 60 seconds to reduce preoxygenation time (6).

The other significant associated factor was patients pre oxygenated <3 minutes [AOR=15.229 95%CI (2.770-84.999)], were developing oxygen desaturation during RSII. The usually recommended time required for preoxygenation was around 3 to 5 minutes with 100% of O_2(19)(29). In a study conducted by M.Helm et al, the patients those preoxygenation for <3 minutes the incidence of episodes of desaturation was 13.3% lower than that found in the present study 67.9%. (7), this difference might be due to the small population sample size

In the other study, this London HEMS the incidence of oxygen desaturation that preoxygenation at least 3 minute was 18.3% the present study is higher this might be due to all professional who performs RSII in the London HEMS were all trained and uses a standard protocol during RSII(31).

The other significant associated factor in patients who have difficult intubation during RSII was assessed by the patients who have > two attempts of intubation with [AOR=22.660;95 %CI (9.842-52.172)]which is high when we compare the other study done by Bodily et al about the incidence and continuously measured of oxygen desaturation during emergency department intubation(AOR 3.4; 95% CI 1.4 to 6.1). This might be due to inadequate preparation.

7. Conclusion and Recommendation

7.1. Conclusion

This finding of the study shows Magnitude of Oxygen Desaturation during Rapid Sequence Induction is relatively low .patients who have documented respiratory disease, those are not preoxygenation, preoxygenation time was <3 minutes and those who have difficult intubation are associated with oxygen desaturation during RSII.

7.2. Recommendation

Based on the finding of this study the following recommendations are forwarded

- Preoperative optimization of patients for emergency surgery.
- Preoxygenate patients for 3 to 5 minutes or use vital capacity preoxygenation techniques for Emergency cases and apneic oxygenation with a nasal catheter as an alternative.
- studies are Limited regarding the magnitude and associated factors of oxygen desaturation during RSII it needs further study about preoxygenation and oxygen desaturation during RSII.

8. Strength and Limitation of the Study

8.1.Strength

- It is a Multicenter study it generalizes the other center.
- No studies are specific to this topic it helps as a reference for other research.

8.2. Limitation

- Difficult to measure the patient's functional residual capacity.

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Annex II. Verbal consent form before conducting the data

Greeting

Hello, my name is _____ and I'm a data collector for the study entitled the Magnitude and Associated Factor of oxygen Desaturation during Rapid Sequence Induction and Intubation at a public hospital. This study aimed to decrease oxygen desaturation by identifying the associated factors predispose to oxygen desaturation since patient desaturation has a serious complication. All the information that you and other participant going to provide us remain confidential and you don't need to mention your name.

Are you willing to participate in the study, please? Yes/No

Thank you for taking part study!

Signature of the observer during data collection.

Signature …….Date……

For further questions ask investigator Kidist TechaleTel:-0947362002

Email:kidteche@gmail.com

Annex III. Questionnaire

Table 1. Socio-demographic characteristics of the status of the patients

Card number		
s.no	Questions	Answer categories'
101	Sex of the patient	1. Male 2. Female
102	Age in years	-------
103	Weight in kg and height in cm respectively.	----------and----------
104	ASA status	1. ASA 1 2. ASA 2 3. ASA 3
105	Preoperative OPV statues	1. OPV 1 3. OPV 3 2. OPV 2 4. Uncooperative
106	Type of operation	1. Elective 2. Emergency
107	Surgical subspecialist	1. General and urology 2. Gynecology 3. Orthopedic 4. Ear, nose,neck,head,extremity 5. Other, specify...
108	Presence of documented respiratory disease	1. Yes 2. No
109	History of documented cigarette smoking	1. Yes 2. No

Table 2 Anesthesia factor during RSII

201	Qualification of the anesthetist handled the procedure.	1. B.Sc. Anesthetist 2. M.Sc. Anesthetist 3. Anesthesiologist
202	Experience of the professional	1. <1year 2. 1-2 years 3. 3-5 years 4. >5years
203	Patient position during induction of anesthesia	1. Supine 2. Semi sitting 3. Lateral

Table 3. Preoperative patient status and preparation for rapid sequence induction and intubation

301	Pre-induction desaturation (if spo2 level is <95%)	1. Yes, 2. No
302	Baseline heart rate, blood pressure, Spo2 level	……bpm …….mmhg……. %
303	Equipment for difficult intubation prepared	1. Yes 2. No
304	Suction machine with a catheter prepared	1. Yes, 2. No
305	Appropriate monitoring prepared	1. Yes, 2. No
306	Oxygen prepared	1. Yes, 2. No
307	Oxygen backup prepared (Ambubag)	1. Yes, 2. No
308	Checklist for RSII prepared	1Yes 2. No

Table 4. Techniques of rapid sequence induction and intubation

401	Preoxygenation	1. Yes, 2. No
402	Time allowed for preoxygenation	1. <3minute 2. 3-5 minutes 3. >5 minutes 4. Rapid preoxygenation with eight deep breaths within 60 s
403	A suction machine connected with the catheter & turned on	1. Before induction 2. After induction 3. Not done
404	Landmark identification for cricoid pressure	1. Before induction of anesthesia 2. After induction of anesthesia but before a loss of consciousness 3. Not done
405	Does the anesthesia professional ask the assistant (Who applied cricoid pressure during RSI) to modify cricoid pressure application during intubation time to improve laryngoscope view?	1. Yes 2. No
406	Qualification of assistance who applied cricoid pressure	1. M.Sc. Anesthetist 2. B.Sc. Anesthetist 3. 3rd-year Anesthesia student 4. 4th-year Anesthesia student 5. Other, specify…… 6. Not done
4o7	Number of laryngoscopy attempts during RSII	1. 1 2. 2 3. 3
408	Prolongation of laryngoscopy attempt in second or minute	……..

409	Ventilate after induction, before intubation, and endotracheal tube cuff inflation during RSII	1. Yes 2. No
410	Does the patient taken aspiration prophylaxis drug	1. Yes 2. No
411	Does the patient take opioid analgesia	1. Yes 2. no If yes specify the drug……
412	Choice of IV induction drugs	1. Ketamine ,dose----------mg 2. Thiopentone, dose--------mg 3. Propofol,dose……..mg 4. Other, specify……
413	Choice of Muscle relaxant	1. Suxamethonium, dose …….mg 2. Other, specify
414	Difficult intubation during RSII	1. Yes 2. No
415	Oxygen desaturation during RSII (if spo2 level is <95%)	1. Yes 2. No
416	If question no 415 answer is ‘’yes ‘Patient Spo2 level during RSII	----------%
417	Desaturation persistent period	1. ……in second 2. …….in minute

Thank you!!